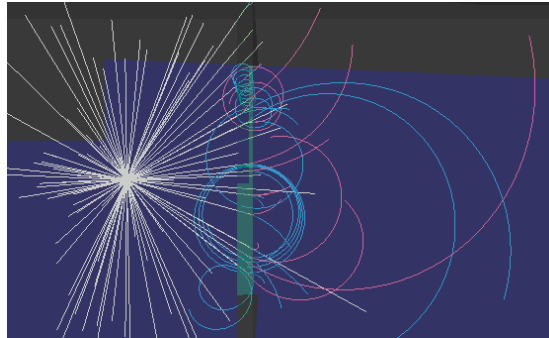


# Virtual Cloud Chamber: Particle Interaction with Matter (Exercises)

## 1. Simulate the creation of electron-positron pairs:

In this example, electron-positron pairs are created through the interaction of 10 MeV gamma photons incident on lead. By “switching off” the electron and positron energy loss mechanisms, the charged particles are seen to spiral in the applied magnetic field. Information on the energies of the electrons and positrons can be obtained from the diameter of the trajectory in the magnetic field.



**For this simulation, use the following parameters (in addition to default values):**

Medium = Vacuum, Source diameter = 0 (point source)

Source to shield distance = 20 cm

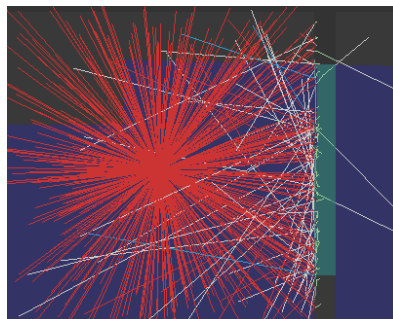
Type of particle = photon, Energy of particle,  $E = 10$  MeV

Number of particles = 100, Magnetic field =  $B_z = -0.1$  tesla

Electron and positron interaction mechanisms (ionization, Bremsstrahlung, scattering, annihilation) all "switched off"

## 2. Simulate the shielding of high energy positrons:

In this example, 3 MeV positrons from the radioactive source are blocked by a lead shield. When the positrons collide with the shield, they combine with electrons to create gamma radiation. Only a few gamma photons pass through the shield material. In this simulation use the following parameters:



**For this simulation, use the following parameters (in addition to default values):**

Medium = Vacuum

Source diameter = 0 (point source)

Type of particle = positrons

Energy of particles = 3000 keV

Number of particles = 1000

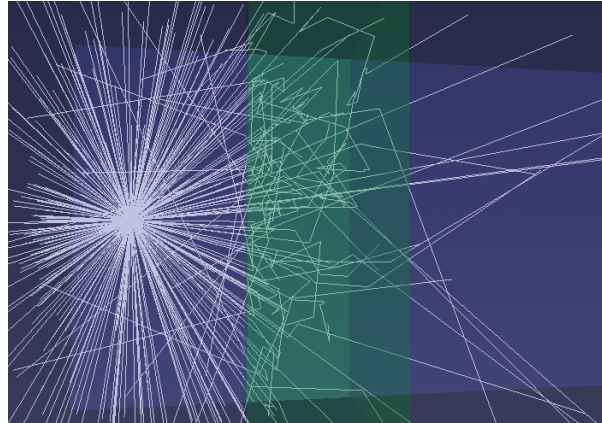
Source shield distance = 20 cm

Shield thickness = 3 cm

All photon, electron and positron interaction mechanisms "switched on"

### 3. Simulate the multiple scattering of low energy photos in water:

In this example, low energy photons (energy 100 keV) are attenuated with a thick (15 cm) water shield. This combination of low energies and thick shields give rise to multiple scattering of the radiation.



**For this simulation, use the following parameters (in addition to default values):**

Medium = Vacuum, Source diameter = 0 (point source)

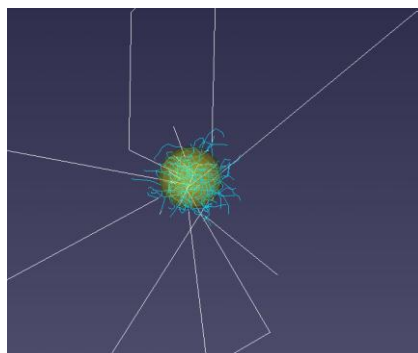
Source to shield distance = 20 cm

Type of particle = photon, Energy of particle = 100 keV

Number of particles = 300, Magnetic field =  $B_z = 0$  tesla

### 4. Simulate of Selective Internal Radio-Therapy (SIRT)

We can simulate the SIRT process using the Virtual Cloud Chamber. For the simulation electrons are selected and the energy is set to 2.28 MeV (2280 keV) corresponding to the maximum beta energy from Y-90. The simulation media selected is water (since that is very similar to tissue). The source diameter is set to 1 cm - this highlights a volume of tissue corresponding to the range of the beta particles.



**For this simulation, use the following parameters (in addition to default values):**

Medium = Water, Source diameter = 1 cm

Type of particle = electron, Energy of particle = 2280 keV

Number of particles = 50, Magnetic field =  $B_z = 0$  tesla